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Personalization of word problems in mathematics has been used to increase student motivation and comprehension. Similar techniques may be effective in other disciplines. In the present study computer techniques allowed integration into stories of personalized referents from an inventory of student interests. Stories were produced at three levels of personalization for 26 students in the 9th, 10th, and 11th grades from a suburban high school in the southwestern United States. A randomized block design was used to determine the order for level of personalization presentation, and a quiz was administered after each story to assess student comprehension. Continuing motivation was assessed using a post project survey which included choice of the level of personalization to be used for a fourth story. Scores were analyzed using ANOVA. Achievement mean scores for the individually personalized treatment were higher than the mean scores for either of the other treatments and they were statistically significant. Results show that personalization of reading materials can increase student comprehension of materials read. (20 references) (Author/BBM)

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Effects of Levels of Personalization on Reading Comprehension

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Abstract

Personalization of word problems in mathematics has been used to increase student motivation and comprehension. Similar techniques may be effective in other disciplines. In the present study computer techniques allowed integration into stories of personalized referents from an inventory of student interests. Stories were produced at three levels of personalization. Students read three stories, one per day. A randomized block design was used to determine the order for level of personalization presentation. A quiz was administered after each story to assess student comprehension. Continuing motivation was assessed using a post project survey which included choice of the level of personalization to be used for a fourth story. Scores were analyzed using ANOVA. Achievement mean scores for the individually personalized treatment were higher than either of the other treatments and statistically significant. Results show that personalization of reading materials can increase student comprehension of materials read.

Effects of Levels of Personalization on Reading Comprehension

Reading comprehension has been a topic for research since the early 1900's when Thorndike concluded that comprehension is thinking and relies on inferential processing (Wilson, 1979). Researchers have continued to study reading as a process, examining characteristics of good readers and poor readers (Beveridge & Edmundson, 1989; Gagné, 1985; Levin, 1973), looking at possible causes for reader's problems, including possible sex related differences (Asher & Gottman, 1973; Asher & Markell, 1974; Beyard-Tyler & Sullivan, 1980; Dwyer, 1973; Edwards, 1981; Marshall, 1984) and motivational factors (den Heyer, 1981; Herndon, 1987; Kinzie & Sullivan, 1989).

In the area of mathematical word problems, personalization has been shown to increase comprehension as well as motivation. Anand and Ross (1987) found that personalized treatments for mathematical word problems promoted higher achievement scores on tests involving context, transfer and recognition tests. Eighth grade Hispanic students in a personalized treatment group scored significantly higher on the constructed-response post-test for one-step and two-step mathematical word problems than those in the standard treatment group. Significant interactions revealed that the overall difference favoring personalization was due primarily to its greater effectiveness with boys (López & Sullivan, 1991). Adaptation of instructional materials to students background was used by Ross, McCormick, Krisak, and Anand (1985) to increase the meaningfulness of the materials produced. The adaptations used by Ross yielded substantial mean score gains on mathematical word problems over scores on unmodified materials.

Bracken (1982) personalized stories taken from a commercially produced reading system and found that poor readers did better on tests of personalized versions of the stories than did poor readers who read the unmodified stories. Poor readers' scores showed substantial increases when compared to the scores of those who read the stories in the standard, unmodified form. No difference was found among scores for children of average reading ability on this variable.

If personalization works, then why don't we use it more? Probably the best answer to this question is that personalized materials have been difficult to produce. Creating a unique version of a story for each student in class is harder than creating one story and duplicating sufficient copies for all students to read. Bracken (1982) suggested that for conventional classroom use a level of personalization might be achieved by incorporating the names of several classmates in a single story rather than creating separate stories for each student. Within the time period of Bracken's research, microcomputers were just beginning to become available, and under typical conditions each story would have been individually typed.

Ross and Anand (1987) call for the automation of materials preparation which incorporates personalization. A portion of the present project was designed to accomplish that goal. As in other studies involving personalization, a student biographical survey was used to gather information relative to each student. After entering these items into a file, a computer mail merge was used to combine the story line with referents from the student data file. The strategy developed in this study allows for flexible placement of any or all items and also provides branching to alternate passages based on the contents of any item of the student data file.

Students' reading scores from the grade 8 testing with the Iowa Basic Skills Test determined placement in Chapter I reading classes. Additional test scores in reading prior to participation in the project (ninth grade, lower quartile in reading

on a nationally normed test) established the eligible pool of students. A second group of students came from two Communications Classes (eleventh grade, two reading grade levels below class). Thus, the participating students were from a sample of "poor readers" from grades 9 through 11.

The purpose of the project was to examine the effectiveness of three different levels of personalized reading materials on student reading comprehension and to initiate a systematic method for creating personalized reading materials for one or more students using existing computers and software.

Level of personalization and gender of subject were used as the independent variables. Individual scores on thematic tests after each story were used as the dependent measure of student comprehension.

Method

Subjects

Twenty-six students in the ninth, tenth, and eleventh grades from a suburban high school in the southwestern United States were included in this study. The students were in four classes taught by two teachers. Subjects were in two Reading classes (n = 8), and two Communication classes (n = 18). Both the eight reading subjects and the 18 communication subjects were balanced evenly by gender for a total of 13 boys and 13 girls. The students in the Reading classes and in the Communication classes were also identified as "At Risk" students due to achievement and attendance histories.

Materials

A 20-item biographical questionnaire was used to collect personal information from each student. Included were questions asking for names of friends who are boys, friends who are girls, favorite color, sports participated in, and favorite foods. Other questions asked about classes students liked most and least. Question selection and phrasing were substituted to maximize the likelihood that all participants would be able to answer each question easily and minimize situations where no answer was possible for an individual. For example, one question asked for the name of a favorite relative, rather than the name of a favorite aunt (or uncle, etc.), since all students have relatives, but not all students might have an aunt or other specific relative.

Three short stories were created. The first person narrative stories dealt with daily school experiences common to high school students. By replacing key words with appropriate personalized referents, one of the three levels of personalization was incorporated into each story. The stories were modified as necessary to achieve a consistent sixth-grade reading level as measured with the Fry Readability Formula (Fry, E. A., 1968).

Three levels of personalization were used in the study; non-personalized, group personalized, and individually personalized. The three levels were selected to represent three common levels of personalization that might be used with materials read by students in a classroom.

The non-personalized version of the story used nouns and pronouns such as teacher, car, and my friend. The stories were approximately 400 words in length and were printed in a two-column format on one side of an 8 1/2 x 11 inch paper.

The group personalized level was created by substituting the highest frequency item by classroom for each question on the student surveys, replacing selected nouns and pronouns in the story. For example, the sentence "My friend and I went to see a movie." becomes "Ricky and I went to see Dances with Wolves." "Ricky" and "Dances with Wolves" had the highest response frequency in the student surveys.

In the individually personalized version the structure was similar, however, referents from the individual student's inventory were used for merging

with the story shell. The non-personalized sentences, "Sunday wasn't too exciting, but I did get to talk with my uncle for a while and later I talked for about an hour on the phone with a friend. We had dinner while we watched TV." became "Sunday wasn't too exciting, but I did get to talk with uncle Carl for a while and later I talked for about an hour on the phone with Chrissy. We had pizza for dinner while we watched The World's Funniest Home Video's." The name of a particular student's favorite relative, a friend who is a girl, favorite food, and favorite TV show were incorporated into the story. In the highly personalized version, each student's story was unique, using referents from that student's own inventory.

The stories were adjusted so that each contained thirty placeholders for referents of generic, group personalized, or individually personalized items.

Each story was followed by a quiz. None of the questions asked for information that would come from student inventory items nor were any questions based on opinion. The questions were content-dependent and required comprehension of the unchanging (non-referent) elements of the story.

Procedures

Students completed a 20-item biographical inventory during their reading class one week prior to reading the first story. Teachers were informed of the necessity to have all items filled in and to tell the students that the information would be used to construct stories that the students would be reading the following week.

The students read one story per day during the last 15 minutes of their reading class. In order to guard against any influence for order of presentation of treatments, the three levels of personalization were blocked so that each possibility of order of presentation was distributed randomly and equally among the students. After reading the story, students completed the ten-item quiz without referring back to the printed story.

Upon completion of all three stories, students again received copies of the three stories they had read and were asked to choose the level of personalization they preferred for a fourth story. The attitudinal survey asked questions about how the students liked the stories, and whether they would like to read more stories personalized at levels similar to the ones they had read. One question asked which story they liked least. An open-ended question asked why the student selected each story identified by the student as liked or disliked.

All quizzes used in the study were scored by a single checker. The answer sheets carried no indication of level of personalization for story presentation.

Criterion Measure

The student's number correct out of 10 questions on each of the three constructed response, thematic quizzes was recorded as a measurement of student comprehension.

Design and Data Analysis

The experimental design was a 3 (personalization) x 2 (gender) factorial repeated measures design.

Results

Mean scores for personalization of reading materials were as follows: individually personalized 8.26, group personalized 6.19, and non-personalized 5.61. A one-way repeated measures analysis of variance was performed to test for differences related to level of personalization (personalized, group personalized, or non-personalized) on story quizzes. The obtained F ratio was statistically significant, $F(2, 77) = 2.52$, $p < 0.001$, with an eta^2 value of .26. A Tukey HSD test revealed that the scores were significantly higher when the story was individually personalized than when it was either group personalized or non-personalized , but

that the means for group personalized and non-personalized did not differ significantly from one another.

The differences for gender and personalization crossed with gender were not statistically significant.

The post-project attitudinal survey indicated that 81% of the students selected an individually personalized version for the fourth story to be read, 15% selected a group personalized story, and seven percent selected a non-personalized story. The post project attitudinal survey question 4 asked why the student liked the personalized story. Twenty eight responses were given noting that the story included friends (several subjects provided more than one response in this category), 15 liked that the story talked about them, and 11 liked that the story included things that the student liked to do. Question 6 asked why the student didn't like the non-personalized story. Sixteen students said it was boring, 15 said it didn't relate to me, and six said the story wasn't true. Results on post treatment quizzes show that students score higher when given individually personalized treatments for each story and that group personalized treatments do not significantly improve scores over non-personalized treatments.

Discussion

Individual personalization clearly had a positive effect on student reading scores. One teacher in the study commented that as the students began to read the first story, he saw a smile come to the face of several students as they read. One of the students who received an individually personalized version of the story spoke aloud, saying that now he knew what the student survey was all about. Subsequently a second student who received a non-personalized version, commented that his story didn't have the names of his friends in it and wanted to know why. At the conclusion of the study, this class asked the teacher if they could keep the personalized stories.

Earlier suggestions that group personalization might be effective were not supported by data gathered in this study. The system used to print all of the stories in the study required additional work to produce the group personalized version because it had to be determined separately which referents had the highest frequency for each class. All stories were printed directly from the computer. A further consideration against group personalization was that a few students objected to being placed into groups, or having certain likes that were not their own used in the story. For example, one referent was for type of music liked. Rap music had the highest referent frequency in one class, and therefore was the inserted referent in the group personalized story for that class. Some students objected, stating strongly that they did not like it when the story made it look as though they liked rap music. Other elements of the story created artificial friendships which some students objected to, usually when cultural or social barriers were crossed.

In a 1986 article on adapting material to student interests, Ross, McCormick and Krisak (1986) state, "A final issue concerns the practicality of the adaptive strategy used. Realistically, few teachers would have the time or inclination to prepare alternative sets of materials to represent different contexts." One possible reason for this type of concern involved the lack of readily available hardware and software to meet the challenge of systematically producing individually adapted materials. The system developed for this project made use of hardware and software commonly available in schools, but requires only a single computer and printer. The printed stories were thus able to be used in normal classrooms without need to schedule computer lab time. For instructors who are not yet comfortable enough with computers and are reluctant to take their classes into a lab setting, this system can be used outside of the classroom and the materials brought to the classroom. Materials created with this system can also be used as homework assignments and do not require the student to have access to a computer.

The benefits of individual personalization of student materials can thus be achieved with minimal investment in computer equipment.

The referents used in the stories were supplied by the students themselves. Inclusion of these items into a story shell that was structured around a familiar setting, the student's own classroom, created a more easily assimilated reading environment. Steffensen, Joag-dev, and Anderson (1979) concluded that "the schemata embodying background knowledge about the content of a discourse exert a profound influence on how well the discourse will be comprehended, learned, and remembered". Since the students supplied parts of the story, they had a personal investment in the product and were motivated to pay more attention to the material.

Further investigation of the effects of this type of treatment is needed to determine if the positive increases evidenced in this study can be sustained over additional treatments. The transfer of any gains in reading comprehension from this program could also be investigated to see if comprehension increased for other materials read, or if the uniqueness of the personalized materials had a limited sphere of motivation.

The strategy used in this study is capable of being expanded to a fully automated system for producing on-demand, highly personalized printed reading materials. With such a system, students could receive materials as they were needed rather than transport a whole semesters worth of materials around as a textbook. This could be structured in a fashion similar to the industrial practice known as JIT - Just In Time inventory control. The strategy could also be adopted to producing text files that could be incorporated into a hypermedia based system capable of presenting on screen reading materials in a variety of settings.

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